RADWAG BALANCES AND SCALES
ADVANCED WEIGHING TECHNOLOGIES

Moisture Analyzers

New methods of moisture content analysis

Moisture Analyzers of 3Y Series

The best possible functionality and professionalism for a drying process and moisture content analysis!

- 5,7" touch screen display
- Interactive menu
- Wireless connection - Wi-Fi
- Control and adjustment system for a drying chamber (GMP)
- Compliance with regulations (GLP System)
- Databases (products, weighings, customers, drying programs, drying processes reports, control and statistics for drying processes reports)
- Dynamic control of sample weight (bar graph)
- Drying parameters optimisation (Test)
- Drying process visualisation (%M, %R, %D, graph)
- Statistics (trend of sample humidity over time)
- Printouts, reports (standard PCL)
- Multilingual menu
- Interfaces: Ethernet (network applications), USB, RS 232
- Wide spectrum of applications (industry, laboratories, universities, research and development institutes)

Home Screen

A Information on a selected working mode and on a current drying mode

B Information on a logged in user

C Area for date, time, information on connection, battery level, etc.

D Pictogram informing on levelling status

E Moisture analyzer indication area

F Weight bar graph

G Bar graph for sample weight control

H Configurable area for supplementary information

I Drying mode / temperature selection

J Auto switch-off option

K Printout interval

L Temperature and elapsed analysis time

M Area defining the drying chamber (Opened / Closed / Drying Process)

N Quick launch bar providing access to functions

O Proximity sensors (optimization of operation)

Admin | 2014.10.05 09:10:00

8765 %M
100%

ON / LOAD

%M
10°

0:18:06
105°C

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.3Y

Maximum efficiency and productivity. Arranging work through databases. History of moisture content variations for a given sample. Easy data exchange between devices. Data protection and access control. Fully configurable screen menu.

Moisture Analyzers of X2 Series

Professional design assuring the highest quality of drying process and maximum comfort of operation.

- 5.7" colour touch screen
- Free customization of menu elements
- Wireless communication
- Control and adjustment system for a drying chamber (GMP)
- Compliance with regulations (GLP System)
- Databases (products, customers, users, packaging, drying programs, drying reports)
- Dynamic control of sample weight (bar graph)
- Drying parameters optimisation (test)
- Drying process visualisation
- Statistics (trend of sample humidity over time)
- Printouts, reports (standard PCL)
- Multilingual menu
- Wide spectrum of applications (industry, laboratories, universities, research and development institutes)

Home Screen

A Displaying home screen

B Exit (return to the previous screen)

C Tare button

D Display shutdown

E Enter/Print button

F Zero button

G Status bar (working mode, moisture analyzer metrological data)

H Area with drying/weighing result

I Information panel

J Quick access key triggering functions and settings

K Current working mode settings

L Proximity sensors

M Drying mode / temperature selection

N Drying process automatic shutdown

O Printout interval

P Temperature and analysis time

R Area defining the drying chamber (Opened / Closed / Drying Process)

DWAG®

MA 60.X2   Max 60g   T=-60g   d=0.1mg

8.814 %M

G   K   L

D

E

F →0←

Użytkownik:
John Smith   I

%M
20   O

0:00:00
25°C   P   R

J

adwag.com

0.000 g

Clear information arrangement. Uncomplicated and intuitive operation as a result of free customization of the menu. Automatically opened and closed drying chamber.

X2.A

Moisture Analyzers of R Series

Advanced technology for a drying process and moisture content analysis!

- LCD display
- Cascading menu
- Wireless connection - Wi-Fi (option)
- Control and adjustment system for a drying chamber (GMP)
- Compliance with regulations (GLP System)
- Databases (users, products, programs, tares)
- Drying parameters optimisation (Test)
- Drying process visualisation (%M, %R, %D, graph)
- Printouts, reports (standard PCL)
- Multilingual menu
- Wide spectrum of applications (industry, laboratories, universities, research and development institutes)

Home Screen

A Elapsed drying time

B Drying temperature

C Area defining the drying chamber (Opened / Closed / Drying Process)

D Moisture content result for a given sample

E Automatic shutdown

F Drying mode

G Measuring unit %M, %D, %R

H Information area

I Direct access to reports on performed drying processes

J Direct access to databases

K Switching drying mode and changing drying temperature

L Selecting sample out of the database

On/Off ⏻

Database

Function

B

C

J

K

L

Profile

Sample

F1 ▶

⊚ ↵

→0← Delete

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101 ℃

816 %ᴹ

OCESS

Compact size and design. Easy and intuitive operation. Direct access to reports and product databases. Ease of data exchange between devices. Versatility of applications in various workstations.

Design and Construction

Measurements Precision in all Thermal Conditions

Moisture analyzer comprises precision balance and a drying chamber joined together. High resolution weighing module is designed to provide quick and precise measurement of a particular sample weight, independently from its thermal condition. Module stabilisation is obtained using special algorithm controlling halogen lamp operation.

A drying chamber

B weighing module

For precise determination of sample weight it is necessary to perform adjustment procedure using external mass standard characterised by a respective accuracy class.

Date	2016.03.12
Time	14:06:27
Balance type	MA 3Y
Balance ID	365661
Operator	Admin
Level status	Yes
Nominal mass	50 g
Current mass	50.0001 g
Difference	0.0001 g
Temperature	22 °C
Signature	

Accuracy is confirmed by a report presenting value of deviation.

Drying Temperature Stability

Drying temperature stabilization is ensured by a heating element (IR emitter) coupled with a temperature sensor. Proper operation of this system is possible owing to adjustment performed in the course of a manufacturing process.

The emitter, as a heat source, is effective when carrying out analysis of various materials: powders, liquids, paste, semi-liquid substances, solid bodies etc.

Graduating drying temperature means comparing and correcting indications of moisture analyzer thermometer. The correction is referred to indications of control thermometer, three measuring points are used for comparison. During the test, the control thermometer replaces a weighing pan.

105°C

$\delta_{(TZ-TK)}$

K - drying chamber temperature
Z - preset temperature
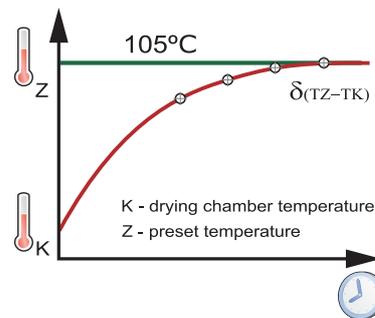
Correctness of thermometer indications (GLP) is checked periodically in the course of operation.

A specific algorithm controlling heating elements operation is needed in order to maintain a particular temperature throughout the drying process. **RADWAG has designed such an algorithm thus ensuring quickness and accuracy of operation independently from analysis duration.**

Drying
Temperature

Heat Source
Types and Intended Use

IRS Halogen

Infrared short
λ = ~ 1,2 μm
mainly convection,
surface heating.

Intended for:
powder, semi-liquids,
liquids.

IRM Emitter

Infrared medium
λ = ~ 3,0 μm
convection and radiation,
deeper layers heating.

Intended for:
most samples of liquid
or semi-liquid consistence,
powders, crushed solids.

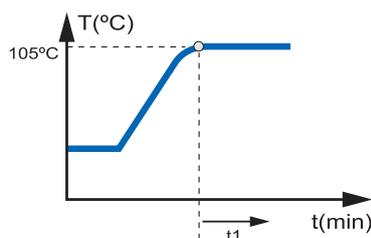### IRL Emitter

Infrared long
λ = ~ 5,0 μm
mostly radiation, sample
volume heating.

Intended for:
bodies of thick consistence
and for solids.

IR emitter is one of the moisture analyzer heat
sources, it operates in a feedback loop.
This ensures thermal conditions stability for the time
of analysis. **RADWAG-designed method for dynamic
control of drying chamber temperature is one of the
factors allowing to obtain short time for analysis
process and repeatability within drying series.**

Methods
for Obtaining the Preset Temperature

Standard Mode

Intended use:
Solid, powder and semi-
liquid samples. Temperature
grows until the determined
value is reached.
**99% of applications.**
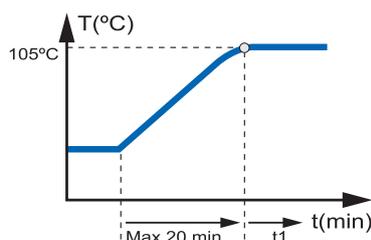
Mild Mode

Intended use:
Mild mode shall be applied
when too fast temperature
growth eliminates
components other than
water.
**Possibility of adjusting
the speed of temperature
growth.**
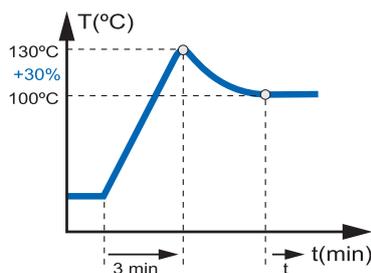
Quick Mode

Intended use:
Samples of high humidity.
In case of overadjustment
the temperature drops until
the determined value is
reached.
**Temperature drop caused
by heat coming from
evaporation is eliminated.**
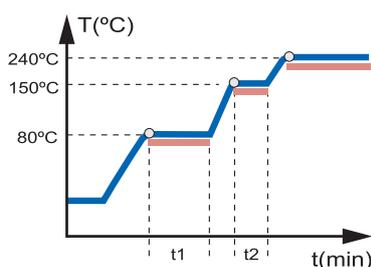
Step Mode

Intended use:
Drying minerals. Chemically
bound water and surface
bound water is eliminated.
**Sample analysis for various
temperature values is
possible.**

Drying Methods

Samples
Types and Preparation

Size of the sample and its preparation shall provide the following: sample structure homogeneity, short time of drying, good repeatability of measurement within a measurement series and drying process result comparable to a reference result (standardised method).

**Solid bodies**
- light sample,
- requires grinding

Samples of low humidity
- heavy sample
 (10 - 15 g)

Liquids
- increasing active surface of evaporation is recomended

Methods
of Analysis Completion

TEST function analyses weight variation for a particular sample, occurring during the drying process. There are 5 different options for automatic shutdown. The user shall select option allowing him to end the drying process in a way ensuring that the obtained humidity value is as close as possible to a reference value. Among other automatic shutdown possibilities there are time-defined, manual and user-defined options, the latest one being the best adjusted to a particular sample characteristics.

m [g]

AUTO 1 (1mg/10s)
AUTO 3 (1mg/60s)
AUTO 5 (1mg/120s)

Δm {
Δt

t1   t2   t3

t (min)

Drying process duration
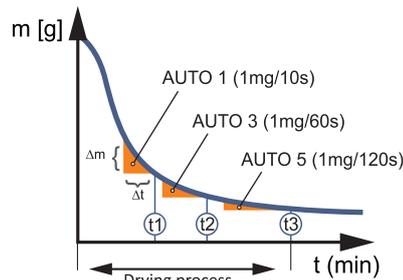
Relations of weight decrease within a specified time interval.

Initial mass	2.7548 g
0:00:10	0.1503% M
0:00:20	0.6258% M
---------- Auto switch off ---------	
0:08:08	Auto 1
Result	11.4789% M
---------- Auto switch off ---------	
0:11:05	Auto 2
Result	11.9058% M
---------- Auto switch off ---------	
0:13:55	Auto 3
Result	12.0502% M
---------- Auto switch off ---------	
0:15:20	Auto 4
Result	12.0858% M
---------- Auto switch off ---------	
0:18:10	Auto 5
Result	12.1526% M

Demonstrative printout of TEST function.

Finish mode

Finish mode

1

m

$$STOP = \frac{1\ mg}{?\ s}$$

STOP   t
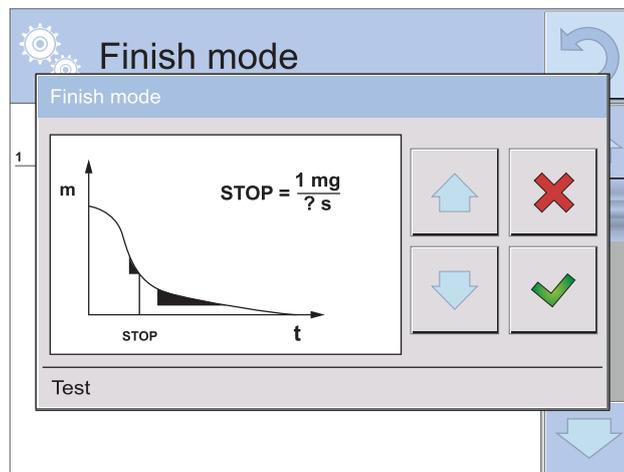
Test

Obtained humidity value depends on start mass of a particular sample – an optimal mass value shall be selected prior running the tests.
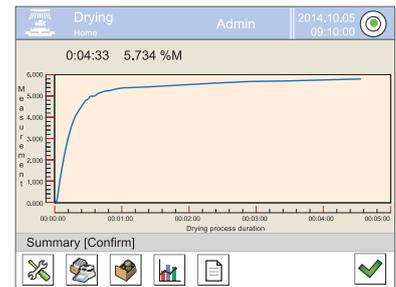
Drying Process Optimization

Automatic Control of Sample Weight

Obtaining optimal results for a drying process depends on samples quantity and weight. Too heavy sample lengthens duration of the drying process. Too light sample works against repeatability of the results. This proves that control of the sample weight is inevitable.

Standard Wheat	Min (3,5g)	Max (4,5g)
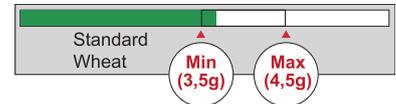
A   **WEIGHT CONTROL** (checkweighing thresholds)

Drying   Home   Admin   2014.10.05 09:10:00

0:04:33   5.734 %M

Summary [Confirm]

B   **GRAPH** (drying process curve, registered for dynamic state)

Edit record

	Name	Candied Chokeberry
1		
2	Code	12345
3	Drying mode	Standard
4	Auto switch-off	Auto 3
5	Result	%M
6	Printout time interval	0:00:30

C   **DRYING PROGRAMS** (drying mode type, temperature, auto switch-off)

Products

33	Coal as a mixture of different size
34	Coal dust
35	Com
36	Com starch
37	Comsilage
38	Cotton

D   **SAMPLES** (name, code, end mass, tolerance, etc.)

Sample description

Equipment related to a sample:
Aluminum disposable pan

Sample preparation:
Spread a sample evenly on the whole surface of the drying pan.

Recommended sample size:
~10 g

E   **SAMPLE DESCRIPTION** (information on how to prepare a sample for a drying process)

Sample Structure Transformation

Unfavorable physical processes, affecting the sample structure, may occur during the drying process. These are caused by dispersion of indications and mistakes made when undertaking assessment of actual moisture content for a particular sample.

Respective method for a particular sample drying, shall be selected based on tests optimizing the sample size, drying temperature and method of analysis end procedure.

Crust Formation
It is a process where an impermeable layer is formed on a sample surface. This makes removal of humidity from the sample impossible. As a result the indication being an outcome of an analysis is lower than the sample reference value.

Sample Burning
Such a process is a consequence of too high drying temperature. It results in a change of sample colour. When sample burning occurs then the sample humidity value is greater than its reference value.

Heat Absorption
Dark in colour samples absorb more heat than the light ones. this accounts for application of lower drying temperatures while drying light in colour samples. Tests need to be carried out in order to select the right temperature value.

GLP
and the Drying Process

Drying
Temperature Control

Drying temperature is a decisive factor for moisture content of a particular sample. The temperature is controlled periodically according to an adopted timetable, wherein the said timetable is specified for a particular temperature value.

Drying Mode
Temperature test is performed for standard drying mode, the most frequently used mode for moisture content analysis.

Temperature
The test is performed for a preset temperature.

Tolerance
Maximum permissible error for a drying process.

Calibration Kit Number
Serial number of a control thermometer.

```
-------- Temperature test --------
Start time          2016.01.30 13:57:05
Balance type                   MA 3Y
Balance ID                      1352
Adjustment kit no.            489/13
Preset temperature            120 °C
Target temperature            119 °C
Measured temperature          121 °C
Permissible error           +/- 3 °C
Status                            OK
----------------------------------
```

The temperature test is performed by means of a special control thermometer.

Time interval for test of both stability and drying temperature accuracy is merely 8-minute long!

Reports and Statistics

Report on Drying Process

RADWAG moisture analyzers allow the user to make self-configured reports. Analysis, summaries, etc. may be printed by means of any office printer (PCL).

The report comprises three sections: the header (A), the data area (B) and the footer (C). Each section can be freely configured by a user.

Drying Process Statistics

Moisture content analyses performed for the same sample are used to determine the sample moisture content variation within a specified time interval (Trend). Trend graph is calculated automatically. Calculating moisture content variation is required wherever manufacturing process and control is performed in a permanent manner. The obtained data is used by systems controlling the manufacturing process. It helps to determine optimal moisture content for a particular sample, required for a finished product prior its packing.
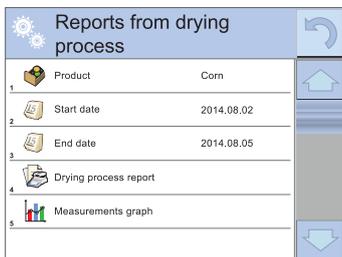
In order to determine trend graph, open a database and specify reference value for sample humidity and permissible tolerance for humidity determination.
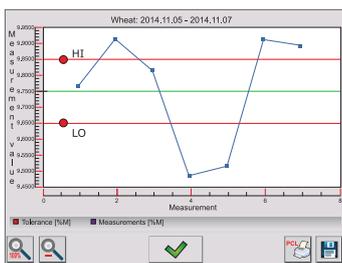
Statistics – trend for moisture content variation over time, calculated automatically for each product.

Edit record (screen)

Start date	2014.10.28 11:34:44	
End date	2014.10.28 11:39:22	
Drying time	0:04:38	
Status	Completed	
Start mass	0.590 g	
End mass	0.506 g	

Reports from drying process (screen)

	Product	Corn
1		
2	Start date	2014.08.02
3	End date	2014.08.05
4	Drying process report	
5	Measurements graph	

Complex drying report (A)

----------- Drying -----------

Start date	2016.03.28
Start time	11:34:44
Operator	Admin
Product	Corn
Drying mode	Corn-PRG01
Drying mode	Standard
Drying mode parameters	100 °C
Auto switch-off mode	Auto
Finish mode parameters	1 mg/60 s
Printout interval	0:00:30
Start mass	0.590 g

(B)

Date and time	2016.03.28 11:35:14
Drying time	0:00:30
Product	Corn
Current result	5.085% M
0:00:30	5.085% M
Humidity content	5.085% M
Dry mass content	94.915% D
Humid / Dry	5.357% R
Tare	0.007 g
Gross	0.567 g
Set temperature	100 °C
Current temperature	99 °C

Date and time	2016.03.28 11:35:44
Drying time	0:01:00
Current result	7.795% M

Date and time	2016.03.28 11:39:14
Drying time	0:04:30
Current result	14.237% M

(C)

Status	Completed
End date	2016.03.28
End time	11:39:22
Drying time	0:04:38
Operator	Admin
Product	Corn
End mass	0.506 g
Humidity content	14.237% M

Simple drying report

----------- Drying -----------

(A)

Date	05.03.2016
Time	6:32:18
Operator	Admin
Product	Prod-01
Program	MAR-1
Drying profile	Standard
Drying profile parameters	90 °C
Finish mode	Manual
Start mass	0.674 g

(B)

0:00:30
0:01:00
0:01:30
0:02:00
0:02:30
0:03:00

(C)

Status	Completed
Drying time	0:03:00
End mass	0.499 g
Result	25.964% M

Example of a simple drying report, generated by MA.R moisture analyzer.

Example of a complex drying report, generated by MA.3Y moisture analyzer.

Measurements graph

Wheat: 2014.11.05 – 2014.11.07

Measurement (x-axis), Measurement value (y-axis)

- Tolerance [%M]
- Measurements [%M]

Databases
Managing and Editing

Databases
Drying Process Ergonomics

Drying parameters such as temperature and automatic shutdown are optimally selected for every single sample. Trying to remember the parameters for just a few samples requires considerable effort. It is more convenient to record the parameters in a database than attempting to learn them by heart.

Product Database
Contains any Data
Relating to a Sample:

- name and description,
- EAN code: searching a sample in a database by means of a scanner,
- target value (%): value used for automatic control of sample weight (bar graph) and for determining moisture content variation over time (trend),
- Min, Max: value used for automatic control of sample weight (bar graph),
- tolerance: value used for determining moisture content variation over time (trend),
- drying program.

Drying Programs Database
Contains any Data
Relating to a Drying Process:

- name, code,
- drying mode, drying temperature,
- automatic shutdown (auto / time-defined / user-defined),
- start mass control (none / optional / essential),
- equipment intended for a sample (methodology),
- instruction on sample preparation for a drying process (methodology),
- required sample size (methodology).

Database
Editor

Database Editor PC software is designed to support users dealing with a vast number of samples. Clear structure of the program ensures quickness when it comes to specifying drying parameters and other information relating to a sample. Data is transferred from the software to a moisture analyzer by means of Ethernet (3Y) or RS 232 (3Y, R).

Available databases: Products, Weighing Records, Customers, Drying Programs, Drying Process Records, Ambient Conditions, Packaging, Warehouses, Printouts, Universal Variables.

Detailed information concerning the product.

Export / import of databases between moisture analyzers.

E2R
Results Analysis Performed Online

Databases
Drying Processes Ergonomics

Production processes for which moisture content of a particular sample is a crucial parameter, require quick reaction. This may be carried out using so called weighing networks comprising MA.3Y and MA.R moisture analyzers. Each drying process is monitored on-line regardless of workstations location.

E2R Moisture Analyzer PC software is designed to record measurements performed by means of RADWAG moisture analyzers cooperating in a network, using RS 232 and Ethernet interfaces for connection. The software enables monitoring and reporting of collected measurements.
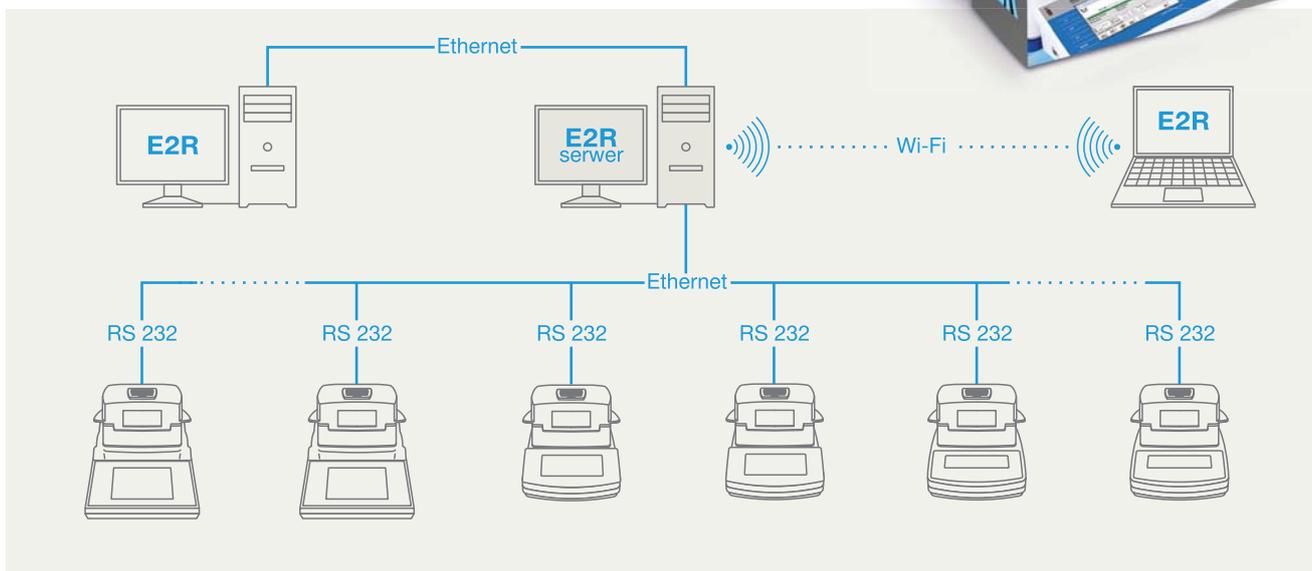
Software functions: on-line monitoring of moisture analyzer operation, possibility of configuring reports and graphs, analysis of data collected from many drying workstations, data protection.
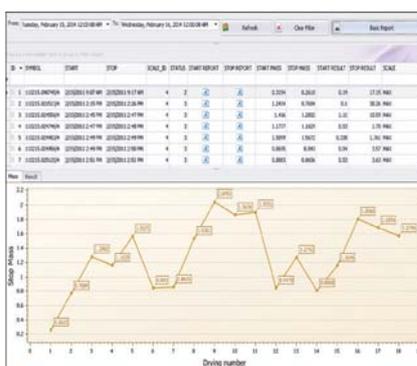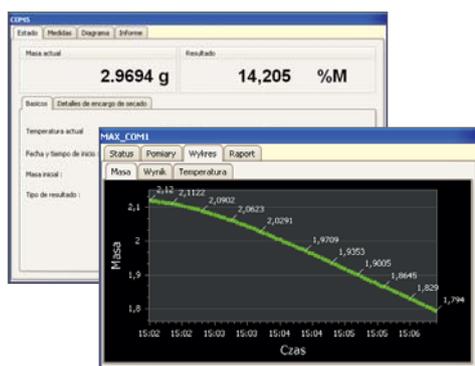
E2R Moisture Analyzer is a module of integrated system for managing E2R weighing processes. E2R System comprises various programs ensuring continuous control of balances and their databases together with both, complete managing of the manufacturing process and the process optimisation.

Intended Use
and Aplications

Area of Use

Moisture content analysis and dry mass measurement of a particular product are both crucial for various branches of industry and science. Vast area of use and diversity of analyzed samples structure require individual approach to different substances.

Dairy Industry

Samples:
cheese, buttermilk, yoghurt, powdered milk, etc.

Samples are dried directly on a weighing pan or by means of glass fiber filters or silica sand (increasing surface of evaporation).

Fruit and Vegetable Industry

Samples:
dried vegetables, fruits and mushroom, nuts etc.

Samples shall be cut into smaller pieces (the analyzed samples cannot be too thick).

Food Industry

Samples:
sugar, flour, pasta, spices, gelatin, etc.

Thin layer of semi-liquid samples shall be distributed on a weighing pan (silica sand or glass fiber filters may be used). Other kinds of samples shall be crushed.

Chemical Industry

Samples:
emulsion, gel and lotions used for cleaning, paints, film, graphite, etc.

Thin layer of semi-liquid samples shall be distributed on a weighing pan (Silica sand or glass fiber filters may be used). Other kinds of samples shall be crushed.

Agricultural Industry

Samples:
grain, seeds, hay, biomass, etc.

Grain needs to be crushed prior drying.

PC Software

RADWAG PC software supports moisture analyzers expanding their functionality.

R-Lab
Scales preview, weighings graphs and statistics graphs.

Database Editor
Readout, databases editing and record of computer stored databases on balance.

Rad Key
Readout of balance data by means of defined Hot Key.

E2R Moisture Analyzers
Record of weighments carried out by moisture analyzers cooperating in a network.

Additional Equipment

- Anti-vibration weighing tables,
- Disposable weighing pans,
- Thermal and dot matrix printers,
- Barcode scanners (for 3Y series),
- Control thermometer,
- Water vapor permeability set.

Complete offer is to be found on www.radwag.com website.

Moisture Analyzers Comparison

MA 3Y

First-class professional moisture analyzers intended for the most challenging applications. They assure excellent accuracy and wide range of functions.

Display
5.7" colour resistive touch screen.

Databases
10 databases (users, products, customers, packaging, warehouses, universal variables, drying modes, weighing reports, ambient conditions).

Level system
Electronic

Bar graph
Bar graph of maximum capacity,
Bar graph for control of sample mass.

Proximity sensors
2 independently programmable IR sensors.

Graphs
Drying process visualisation.

MA X2.A

Advanced moisture analyzers intended for most applications. They guarantee high quality measurements along with easy and convenient operation.

Display
5" colour capacitive touch screen.

Databases
8 databases (users, products, customers, packaging, drying programs, drying reports, weighing reports, ambient conditions).

Level system
Bull's eye level.

Bar graph
Bar graph of maximum capacity.

Proximity sensors
2 independently programmable IR sensors.

Automatic drying chamber
Automatically opened and closed drying chamber.

Prognosis of the drying process result
Prognosis function (max. 6-fold reduction of the drying time).

MA R

Versatile and reliable standard moisture analyzers. They are characterized by high measurements accuracy, uncomplicated operation and robust design.

Display
Large, monochromatic LCD with backlight.

Databases
6 databases (users, products, packaging, drying programs, drying reports, weighing reports).

Level system
Bull's eye level.

Technical Specification

	MA 60.3Y	MA 200.3Y	MA 50/1.X2.A	MA 50.X2.A	MA 110.X2.A	MA 210.X2.A
Maximum capacity [Max]	60 g	200 g	50 g	50 g	110 g	210 g
Readability [d]	0.1 mg	1 mg	0.1 mg	1 mg	1 mg	1 mg
Tare range	-60 g	-200 g	-50 g	-50 g	-110 g	-210 g
Maximum sample weight	60 g	200 g	50 g	50 g	110 g	210 g
Moisture readout accuracy	0.0001 %	0.001 %	0.0001 %	0.001 %	0.001 %	0.001 %
Moisture content repeatability for ~2g sample	0.05 %	0.05%	0.05 %	0.05 %	0.05 %	0.05 %
Moisture content repeatability for ~10g sample	0.01 %	0.01 %	0.01 %	0.01 %	0.01 %	0.01 %
Drying temperature range	max 160°C. max 250°C (option)		max 160°C. max 250°C (option)			
Heating element	IR emitter, halogen (option), metal heater (option)		IR emitter, halogen (option), metal heater (option)			
Power of heating element	400 W		400 W			
Drying mode	standard, quick, step, mild		standard, quick, step, mild			
Drying shutdown options	manual, automatic, time-defined, user-defined		manual, automatic, time-defined, user-defined			
Touch-free operation	programmable sensors		programmable sensors			
Automatically opened drying chamber	○		●			
Additional functions	sample identification, drying process graph		control of sample weight before drying process			
Operating temperature	+10°C - + 40°C		+10°C - + 40°C			
Weighing pan dimensions	ø90 mm, h = 8 mm		ø90 mm, h = 8 mm			
Display	5.7" touch screen		5" colour capacitive touch screen			
Communication interfaces	2×USB-A, RS 232, Ethernet, Wireless Connection, 4×IN/OUT		USB-A, USB-B, RS 232, Ethernet, Wireless Connection			

MA 50/1.R	MA 50.R	MA 110.R	MA 210.R
50 g	50 g	110 g	210 g
0.1 mg	1 mg	1 mg	1 mg
-50 g	-50 g	-110 g	-210 g
50 g	50 g	110 g	210 g
0.0001 %	0.001 %	0.001 %	0.001 %
0.05 %	0.05 %	0.05 %	0.05 %
0.01 %	0.01 %	0.01 %	0.01 %
max 160°C. max 250°C (option)			
IR emitter, halogen (option), metal heater (option)			
400 W			
standard, quick, step, mild			
manual, automatic, time-defined, user-defined			
○			
○			
sample identification			
+10°C - + 40°C			
ø90 mm, h = 8 mm			
LCD (backlit)			
USB-A. USB-B. RS 232. Wireless Connection (option)			

READ
QR CODE

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